THE KANSAS UNIVERSITY SCIENCE BULLETIN.

Vol. IV, No. 20—September, 1908.
(Whole Series, Vol. XIV, No. 20.)

CONTENTS:

South American Archeological Notes, ... *H. T. Martin.*

PUBLISHED BY THE UNIVERSITY,
Lawrence, Kan.

Entered at the post-office in Lawrence as second class matter.

STATE PRINTING OFFICE,
TOPEKA, 1908.
2540

KANSAS UNIVERSITY SCIENCE BULLETIN.

VOL. IV, No. 20. SEPTEMBER, 1908. {WHOLE SERIES, VOL. XIV, No. 20.

SOUTH AMERICAN ARCHEOLOGICAL NOTES.

By H. T. MARTIN.

(Contribution from the Zoölogical Laboratory, No. 187.)

Plates XXXVIII to XL; four text figures.

IN the spring of 1903, while on a fossil-hunting expedition in Patagonia, South America, I accidentally discovered a very unique form of human skull in a canyon close to camp. At the time of the find nothing could be seen of more than passing interest in the bones, owing to their fragmentary condition, but recently, upon mending the broken parts, I was surprised at the unusual shape and contour of the skull. The exact locality of the find is at the mouth of a canyon on the estancia of Mr. H. S. Felton, at Killik Aike Norte, on the Rio Gallegos, about half a mile below his house, and 100 yards from the river bank into which the canyon empties. The place is shown in the photograph on plate XXXVIII, where the small cross can be seen, to the right and just beyond the camp. The most plausible explanation for its presence here appears to consider that it had been washed down from its original resting-place on the adjacent high hills which occur on either side of the canyon's edge for a distance of two or three miles inland.

Although very careful search was made, no other portions of the skeleton could be found at this point. From the nature of the surroundings, and the condition of the skull when found, there does not appear to be any possibility of determining its geological age, but after careful study and comparison there appears not the least doubt that it represents a race of people now extinct in that part of Patagonia.

The skull when found was embedded in the silty debris and wash from the hills, with its palatine surface uppermost. Only a small portion of one side of the maxilla was found, which con-

tained portions of two molars, and unfortunately the contact between the piece of jaw and skull is broken away.

By referring to plate XXXIX, figures 1 and 2, the observer will see that the skull is of a decidedly hyperbrachycephalic type, being nearly as broad as long. The whole of the frontal region is very low and flat. The frontal eminence is made to appear more prominent by the presence of a slight, almost flat, depression, which occurs between the supercillary ridge and the frontal eminence. The temporal ridge is sharp and rather prominent, and as it extends backwards appears to take more of an upward trend, rather than a downward curve as is usual when it reaches the region of the parietal, thereby giving the frontal bone a more angular appearance.

By referring to plate XXXIX, figure 2, it will be seen that the parietal protuberances are very pronounced. The temporal fossa are deeper than is usual.

From the front the malars appear square, much resembling those of the Esquimaux. The supercillary ridge is very high. The superior border of the orbital arches is straight, and shows very little rounding to form the orbital apertures, but turns at a very sharp angle at both ends, making the upper portion of the orifice almost square. The glenoid fossa is rather shallow, but very broad. The following measurements have been made:

Antero-posterior diameter, 15.7 mm.

Transverse diameter, 15 mm.

Top of cranium to auditory fossa, 12.3 mm.

Cephalic index, 95.54 mm.

Nowhere does the skull show any deformation by artificial means.

By way of comparison with the specimen just described, it has been thought advisable to give a reproduction of another very fine skull and lower jaws, also found by the writer in the Argentine Republic, at the port of San Blas, in the Rio Negro territory, about 600 miles south of Buenos Ayres. This specimen shows a very marked difference from the one previously described, and, judged not only by its proportions and shape but by the excellent examples of pottery and arrow-heads found associated with it, must have been of a race far more advanced than the Killik Aike specimen from Patagonia.

The skull shown on plate XXXVIII, figure 1, although having a rather low, slightly receding forehead, taken alto-

gether is very well proportioned, and would average as well as most of our North American Indian skulls in point of development. The triturating surfaces of the teeth show an abnormal amount of wear for an individual the age that one would judge this to be. This is owing, no doubt, to the large amount of grit found in some of the food used, such as shell-fish, and fish cast upon the shore, together with the tough meat of the guanaco, which must have constituted their principal food. A good view is shown of the sand-hill blowouts in figure 1. The

FIG. 1. View showing burial ground in sandhills at San Blas where pottery and skull No. 1 was found.

exact spot where the specimen was found is marked by the small cross. The ever-moving sand here offers an excellent opportunity to find good skeletons, quite a number having been discovered here.

Plate XL, figures 1 to 10, show some photographs of relics found associated with the San Blas specimen. It is interesting to note that nearly all of the pottery is of the incised variety, made by a process much practiced by the old Pueblo Indians, namely, of indenting by a notched piece of wood or bone. Several of the pieces show much skill in their manufacture, as well as fine taste in the decorations. The design on No. 1, the largest piece in the collection, a portion of a bowl probably ten inches in diameter, is all incised work. The pattern appears to

have been composed of four shallow horizontal impressions three-fourths of an inch apart and one-fourth of an inch wide, indented every eighth of an inch by perpendicular incisions. The three-fourths of an inch space between the incised bands is decorated by a zigzag row of small holes pressed in with a small, round-pointed tool, held at an angle of seventy-five degrees (see text, figure 2). Beneath this is a two-inch square

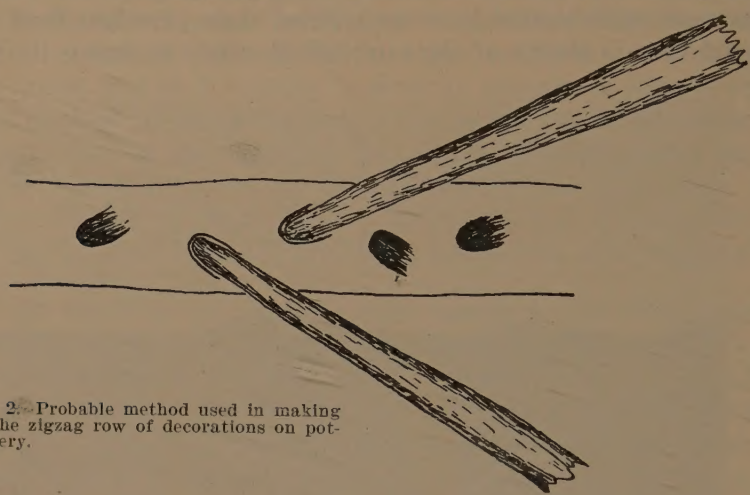


FIG. 2.—Probable method used in making the zigzag row of decorations on pottery.

checkerboard design surrounded by the quarter-inch wide pattern described above. Adjoining this is a small triangular-shaped decoration of indentations, then a diamond-shaped checkered pattern, in size and design similar to the square.

Nos. 2, 3 and 4 are of simple design. Nos. 3 and 4 were probably incised with the finger nails. The pattern on No. 5 is made with a two-pronged incisor. On No. 6 are two rows of indentations different in shape from any of the others. These are crotchet-shaped impressions, and look as though made with the proximal end of a small fish rib. No. 10 shows the most elaborate decoration, apparently made chiefly with a four-notched tool, with a decoration on the inside of the rim as well. All of the pottery shows an advanced stage in the ceramic and decorative arts. The arrow-points shown are all well made. About fifteen were found close to the grave along with the pottery. No painted pottery was found, and no boleadores.

The pipe shown in the text, figures 3 and 4, is the only one the writer heard of being found anywhere along the Patagonian coast. This was presented to him by Mr. John Rudd, at

Cape Fairweather, and was found by him on his estancia about five miles above the point of Cape Fairweather, on the Rio Gallegos.

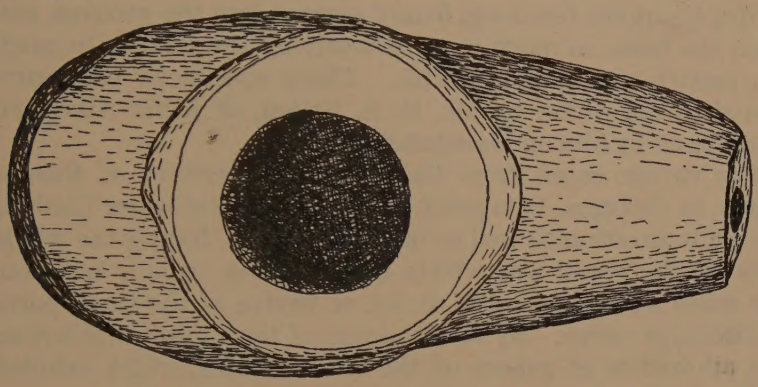


FIG. 3. Upper view of pipe found on the Rudd Estancia.

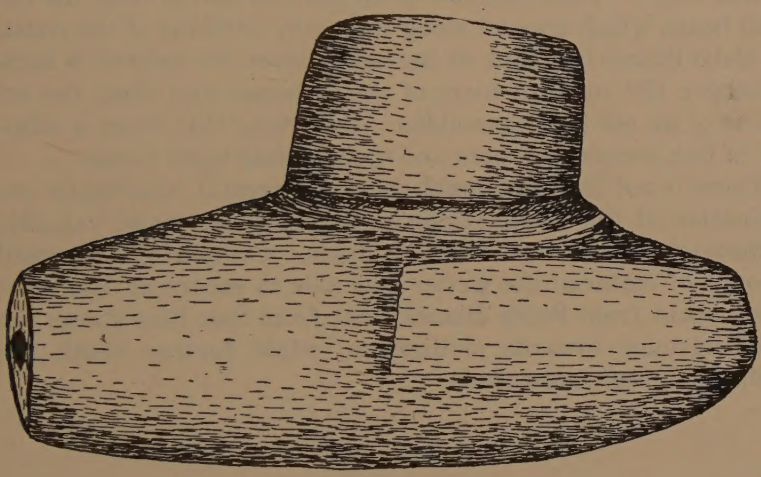


FIG. 4. Side view of same pipe.

At about a dozen other points of call along the coast a goodly number of arrow-heads and boleadores were found, generally associated with the shell heaps or kitchen-middens along the coast. At Port Deseado one of these heaps was excavated to a depth of over three feet without finding bottom. It is composed of limpet shells and is twenty-five yards long by fifteen wide.

On plate XXXI some very fine examples of boleadores are shown. These are of a pattern now obsolete, having been sup-

planted by the rawhide-covered ones now used. Nos. 1 and 2 are made of heavy granite, No. 3 of a hard sandstone. Usually two of these are used fastened together by twisted rawhide strips, about six feet long, firmly secured into the grooves, and form the bolas so much used formerly by the Gaucho to catch the ostrich and guanaco with. These specimens were presented to the writer by Mr. H. S. Felton, of Killik Aike, and were found by him on his estancia.

The voyage south from Bahia Blanca, territory of Buenos Ayres, to Gallegos, Patagonia, on the coasting steamer Chubut, was an interesting as well as instructive one. Nearly the whole distance the vessel was within sight of land, usually not over two miles away, and called at ten or twelve of the small ports to discharge cargo. By the kindness of the captain the writer was allowed to go ashore on the steam launch, which enabled him to gather at all the points visited a small collection of Indian relics. These are not at all hard to find around the old shell heaps which abound along the rocky portions of the coast. At Cabo Blanco one bank of the small bayou we entered is composed for 150 yards or more of shells, bones, and sand, the remains of an old kitchen-midden. By caving this down a number of fine arrows, scrapers and spear-points were found.

There is not the least doubt that by a careful, systematic examination of the whole region, a very extensive and valuable archeological collection could be made. Comparing the small amount of material the writer was able to secure at each port going south from Bahia Blanca, that from San Blas shows the most advance towards civilization, while further south the weapons appear more crude.

PLATE X.

Caudal view of pectoral girdle of *Xiphactinus, ca.* ½. This specimen shows the halves of the girdle in their normal relations, as it does also the individual bones. The extent of apposition between the halves, and the articulations for the fin-rays, appear clearly.

PLATE XI.

Reconstruction of the left half of the pectoral girdle of *Xiphactinus*, *ca.* ½. External view showing the extent and relations of the elements. All parts of the girdle are represented in specimens studied and the figure is merely a composite.

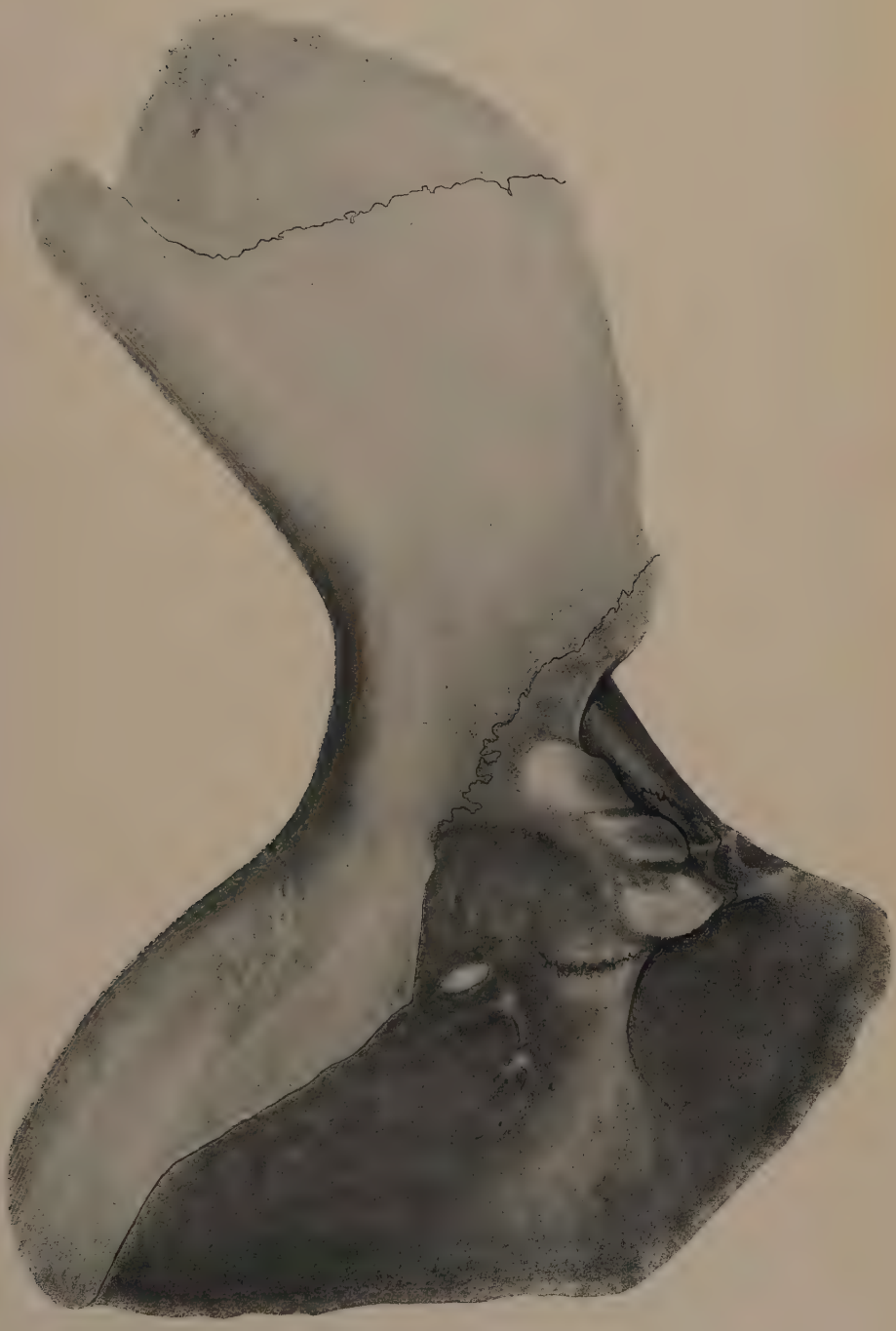


PLATE XII.

From a photograph of the restoration of *Xiphactinus* in the museum of the University of Kansas. This is a composite of several specimens, the only parts in plaster being the ends of the pectoral fin-rays, part of the ribs, and portions of the girdles. The restored bones are modeled from specimens.

PLATE XIII.

The caudal fin of *Protosphyræna*, showing the urostyle, the fin-rays, and the ossified neural and hæmal arches. The absence of ossified centra is apparent.

1/2

Plate XIV shows the restoration of the skeleton of *Bison occidentalis*.

EXPLANATION OF PLATE XV.

The original *camera lucida* drawings are at a magnification of 3000 diameters, and appear here at 2000. The optical equipment with which the preparations were studied consists of an apochromatic objective of 2 mm. focus and 1.40 N. A., and compensating oculars. The light of the Welsbach mantle was delivered to the objective through a Watson oil-immersion condenser of 1.30 N. A.

FIG. 1.—Telophase of secondary spermatogonium, showing the ends of the divided accessory chromosome almost in contact.

FIG. 2.—Telophase of similar cell, showing the accessory chromosome *en face*.

FIG. 3.—Same stage as figure 2.

FIG. 4.—Same as figure 2, but with the halves of the accessory chromosome more separated.

FIG. 5.—Various forms of the accessory chromosome in the prophase of the first spermatocyte. Those represented at *a*, *b*, *c*, were fixed in Flemming's fluid and stained in iron-hæmatoxylin; the remaining ones were fixed in Hermann's fluid and stained with safranin-gentian violet. The latter combination causes the elements to appear larger than the former. Variations in the form of the accessory chromosome, at about the same stage, are shown at *d*, *e*, *f*, *g*, *h*. The elements shown at *i*, *j*, *k*, *l*, *m*, *n*, are of later stage. Chromosomes *m* and *n* are from the same cyst, the former being a lateral view, the latter *en face*.

FIG. 6.—Polar view of a metaphase of the first spermatocyte, showing the sixteen ordinary chromosomes and the accessory chromosome beneath.

FIG. 7.—A slightly later stage than that represented in figure 6. No accessory chromosome shown.

FIG. 8.—Polar view of the first spermatocyte metaphase, showing the sixteen ordinary chromosomes.

FIG. 9.—Similar to figure 8.

FIG. 10.—Lateral view of a first spermatocyte metaphase, showing a few of the chromosomes. The one in the form of a ring lies in the plane of the spindle axis.

FIG. 11.—Same stage as represented in figure 10, but showing the accessory chromosome at one pole of the spindle.

FIG. 12.—Telophase of the first spermatocyte, showing the accessory chromosome in only one daughter-cell. 12*a* and 12*b* are views of the accessory chromosome in the same stage but with different degrees of chromatid separation.

FIG. 13.—Polar view of second spermatocyte metaphase in which the accessory chromosome is present.

FIG. 14.—Similar to the cell shown in figure 13.

FIG. 15.—Polar view of second spermatocyte without an accessory chromosome.

FIG. 16.—Lateral view of second spermatocyte with an accessory chromosome.

FIG. 17.—Mid-anaphase of second spermatocyte, showing separation of halves of the accessory chromosome.

FIG. 18.—Similar to figure 17.

FIG. 19.—Telophase of second spermatocyte, showing presence of the accessory chromosome in daughter-cells.

FIG. 20.—Telophase of second spermatocyte without the accessory chromosome.

FIG. 21.—Somatic cell in anaphase showing division of the accessory chromosome.

1
2
3
4
5
a
b
c
d
e
f
g
h
i
j
k
l
m
n
6
7
8
9
10
11
12
12a
12b
13
14
15
16
17
18
19
20
21

PLATE XVI.

Drawings made at a magnification of 2250. In reproduction this has been reduced to 1800 diameters.

FIG. 1.—Spermatogonium, showing twenty-three chromosomes. 12, the largest chromosome of the complex; 1, the smallest; 9, a chromosome showing the longitudinal split.

FIG. 2.—Prophase showing the accessory smooth in outline and darkly staining; 4, a chromosome exhibiting the true tetrad character; 12, the largest chromosome.

FIGS. 3A and 3B.—A single cell showing the full number of chromosomes in a first spermatocyte metaphase in lateral view.

FIGS. 5, 6, 7.—Polar views of first spermatocytes, showing the occurrence of the single ring.

FIG. 8.—Prophase. Chromosome 12 in the form of a cross.

FIG. 9.—Polar view of the first spermatocyte, showing three rings.

FIGS. 10A and 10B.—First spermatocyte metaphase, with the chromosomes numbered in the order of their size: No. 10, the ring in profile; No. 6, the accessory.

FIG. 11.—Early anaphase of the second spermatocyte, showing the separation of paternal and maternal elements.

FIG. 12.—The chromosome complex of a first spermatocyte, showing the graduated series of chromosomes.

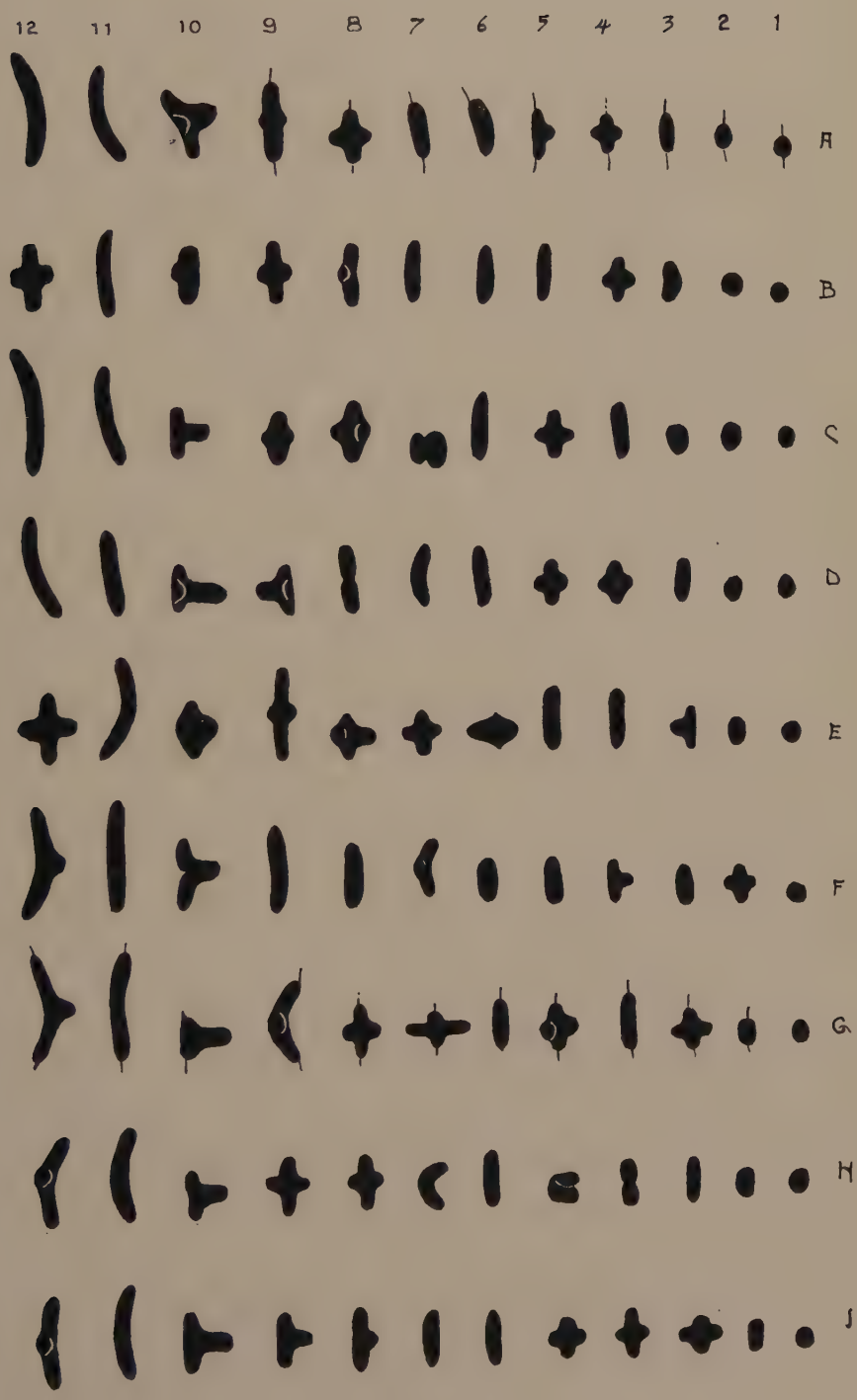
FIG. 13.—A polar view of the second spermatocyte, with eleven chromosomes. The accessory is absent.

FIG. 14.—A polar view of the second spermatocyte, showing the full number of chromosomes.

1
2
3A
3B
4
5
6
7
8
9
10 A
10 B
11
12
13 A
13 B
14 A
14 B

PLATE XVII.

The chromosomes of nine first spermatocytes, as seen from a lateral view of the metaphase.


12
11
10
9
8
7
6
5
4
3
2
1
A
B
C
D
E
F
G
H
J

EXPLANATION OF PLATES XVIII, XIX, XX.

All drawings were made by the author with the aid of an Abbe camera lucida, and are reproduced here at a magnification of about 1895 diameters. They are numbered as nearly as possible in the order of their development. Figures 7, 8 and 9 are the only exceptions. They represent the earliest cells that were studied, and have been placed with the later spermatocyte stages merely for convenience. Figures 1-6 and 30-46 are from cells stained with iron-hæmatoxylin and figures 7-29 from those stained with Flemming's tricolor.

FIGS. 1-6.—Spermatogonia, polar views of the metaphase. Figures 1-4 are from a single individual and 5 and 6 from two others. There are twenty-three chromosomes in each cell. The larger of them lie in the outside portion of the plate and the smaller ones nearer the center. The chromosomes are usually split (figs. 1, 2 and 6) and the halves ready to go to the poles. The separation of the halves begins at the inner end of the chromosome (fig. 6).

FIG. 7.—Early secondary spermatogonium. *X*, Accessory chromosome in its vesicle. *N*, Nucleoli, weakly stained but homogeneous.

FIG. 8.—Spermatogonium, late telophase, within a cyst of about twenty cells. *X*, Accessory, its vesicle well shown. *N*, Nucleoli stained with safranin.

FIG. 9.—Another cell from the same cyst. Accessory seen in cross-section within its vesicle; other chromosomes in cross-section also.

FIGS. 10-15.—Different stages from one follicle, not long after the last spermatogonial division.

FIG. 10.—Spermatogonium, telophase just after the last division. Cells of this stage are deeply stained. The nucleus is at its smallest volume here. The ordinary chromosomes begin to loosen up. The accessory remains condensed. The occurrence of two nucleoli in each cell seems to be quite general for the cyst.

FIG. 11.—Telophase later than the above; in a neighboring cyst. The chromatin is well diffused. *N*, *N*, Two faintly stained irregular nucleolar bodies; nucleus still small. *K*, Karyosome, probably.

FIGS. 12, 13, 14, 15.—Spermatocytes, growth period. All from same cyst. Accessory much condensed and massed into an irregular lump, still clinging to the nuclear wall. Two nucleoli present in each cell, stained with safranin like the accessory, sometimes differing slightly in size. In figures 14 and 15 they lie in close contact, possibly uniting. In the cells at the proximal end of this follicle there is but a single nucleolar body besides the accessory present. This body is about equal in volume to the two nucleoli, such as in figures 14 or 15. *K*, Mass of chromatin, probably a tardy loosening up of a chromosome.

FIGS. 16-22.—Spermatocytes, growth period following the above. All from one follicle.

FIG. 16.—Accessory and nucleolus shown. But one of the latter present. It takes the safranin stain like the accessory. Every cell in this cyst has but one of these nucleoli. Sometimes they show a tendency to lose the safranin color and appear dark purple. Accessory is larger than the nucleolus and happens in this case to lie against that part of the nuclear wall which is uppermost; but nevertheless it is in contact with the wall.

FIG. 17.—From the same cyst as above. Accessory is vacuolated, as is quite frequently the case. Nucleolus and accessory are at almost opposite sides of the nucleus.

FIG. 18.—From a neighboring cyst but at same stage as figures 16 and 17. Shows condition of ordinary chromatin in figures 16-19. Nucleolus and accessory lie close together but are separate. Nucleolus is homogeneous but not nearly so dense as accessory. *t*, A tetrad beginning to show the splitting of the thread, the longitudinal division. *p*, A plasmasome, not found in every cell.

FIG. 19.—From same cyst as figure 18. *t*, Possibly the end of a tetrad; stained with safranin. It seems not to be typical for all the cells of the cyst, for no others were found in the cyst showing this second body so prominent or so deeply stained.

FIG. 20.—Shows extreme looseness of the accessory. It is spread out upon the inner side of the upper part of the nuclear membrane. The nucleolus, besides becoming very irregular, is losing its staining power.

FIGS. 21, 22.—Slightly later stage than any of the preceding. The nucleoli are stained purple instead of red. Many others of this cyst have lost their stain. Some, however, still remain red. The nucleoli appear to be still homogeneous. The small dark bodies present are possibly small globules of chromatin already condensed. One accessory is vacuolated.

FIG. 23.—Accessory shows indications of forming a spireme.

FIG. 24.—Accessory is farther advanced. The nucleolus has lost its safranin-staining ability. *t*, A tetrad that is in advance of its fellows. The proximal ends are much condensed and stain safranin.

FIG. 25.—Shows the spireme condition of four other accessories in the same cyst from which figure 24 was taken. No indication of a special bending in the middle. It is merely an irregular coil. The diameter is very small and the length correspondingly great.

FIG. 26.—A later condition. The accessory is shortened and its diameter correspondingly increased. Five tetrads shown. *XX*, Parts of the tetrad to which the fibers from opposite poles of the spindle will be attached. Nucleolus entirely yellow or colorless but homogeneous. A count of the chromosomes at this stage shows the full number twelve, plus the nucleolus. It is therefore safe to say that the nucleolus is not a chromosome. Another evidence of its nucleolar origin is the fact that it degenerates and loses its staining ability. This takes place about the time that the chromatin is being contracted into the form of chromosomes. Clear spaces appear in the nucleus between the chromosomes at this time. The nuclear wall is still intact. In general the follicle is lightly stained as compared with other follicles and the nucleoli are rather inconspicuous in the cells at all stages.

FIG. 27.—Accessories from other cells in the same cyst as figure 26. All at the same stage.

FIG. 28.—Still later stages, showing the gradual shortening and thickening and the final straight or rod form. No indication of bivalency.

FIG. 29.—Various shapes seen among the ordinary chromosomes in the last prophase. All belong to the same type, that of the cross (*a*), and are modifications of it. *XX*, Places of attachment for the spindle fibers from opposite poles. They indicate the "proximal" end, or part, of the chromosome, the place where the members of the spermatogonial pair always come in contact. They also mark the ends of the transverse axis of the cross. A line drawn through this axis would divide the chromosome reductionally, through the opposite axis longitudinally. It is divided longitudinally the first time and reductionally in the second division. The ends of the longitudinal axis may be bent over toward each other and brought in contact, forming the rings (*f*, *i*) or the figure of 8 (*g*). If not brought in contact the semiclosed ring (*e*) or kidney and bent-rod forms may result. *a*, Cross, simple type form. *b*, Ring. *c*, Cross, ends of longi-axis bent towards each other. *d*, Another view of same. *e*, Semiclosed ring. *f*, Ring. *g*, Ring twisted in form of figure 8. *h*, Another cross. *i*, Ring greatly pulled out into transverse axis. *j*, Shows cross form among the smallest chromosomes of the complex.

FIG. 30.—Polar view of first spermatocyte metaphase. Plate viewed at an angle of 25 degrees from the perpendicular. Twelve chromosomes present, all visible in one section. Chromosomes No. 3 and 5 displaced slightly outward for convenience in drawing.

FIG. 31.—*Idem*, from same animal as above. Twelve chromosomes in their exact position. The whole eleven ordinary chromosomes may be seen at one focus. The accessory is nearer the upper pole and hence not in the same focus as the eleven.

FIG. 32.—*Idem*. Chromosomes farther advanced in mitosis than in figures 30, 31 and 33.

FIG. 33.—All in exact position except No. 7, which lay partially over No. 8. Note the smaller chromosomes in the center and the larger ones in the outer portion of the plate. The accessory is traveling toward the farther pole.

FIG. 34.—A fragment of a cell. Lateral view of the metaphase, showing position of the accessory at periphery of the cell-plate. One end only has a spindle fiber attached. *XX*, Points on ordinary tetrads where spindle fibers are attached.

FIG. 35.—Another fragmentary cell, showing the same conditions.

FIG. 36.—*Idem*.

FIG. 37.—Metaphase, eleven chromosomes dividing. The accessory is seen going off to one pole undivided. Chromosomes displaced somewhat to right and left in order to show each one more clearly.

FIG. 38.—Anaphase of the first spermatocyte mitosis. Oblique polar view. Eleven dyads at upper pole and eleven plus the accessory (No. 5) at the lower pole. The end of the accessory towards the plate has split widely while the proximal end is still intact.

FIG. 39.—*Idem.* Same view. Eleven dyads at lower pole and eleven plus the accessory at the upper.

FIG. 40.—Second spermatocyte metaphase. Eleven dyads present, plus the accessory, which is about the size of the No. 10's as in the spermatogonia. Because of its failure to divide in the last mitosis, the accessory is just twice as large in comparison with the other chromosomes.

FIG. 41.—Second spermatocyte metaphase. Eleven dyads present, but no accessory. The unnumbered element near the center of the complex does not belong in the cell. It is a spot of ink that accidentally got on the drawing and was overlooked in the correction of the proof. In this and the preceding cell the relative sizes of the chromosomes are very apparent. Nos. 12, 11 and 10 may easily be recognized by their large size, and 1, 2 and 3 by their small size.

FIG. 42.—Second spermatocyte anaphase, eleven chromosomes.

FIG. 43.—*Idem.*

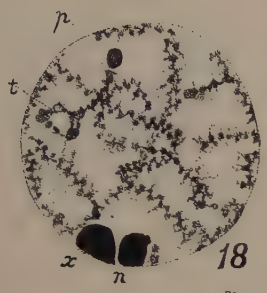
FIG. 44.—Second spermatocyte anaphase, twelve chromosomes.

FIG. 44*a*.—Fragment of figure 44 found in next section.

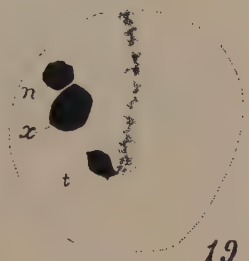
FIG. 45.—Another second spermatocyte anaphase, twelve chromosomes. The large round element in the left part of the figure is not present in the cell but is the result of the same accident as that in figure 41. It is to be disregarded.

FIG. 46.—A spermatid of the twelve-chromosome type. Accessory viewed from end.

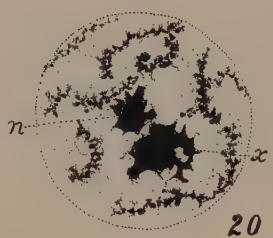
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17



18

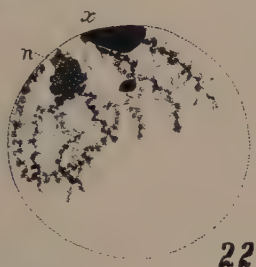


19

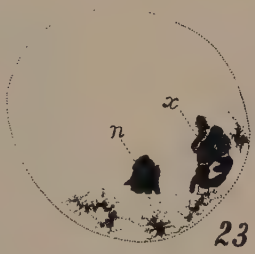


20

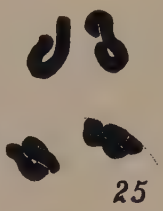
21



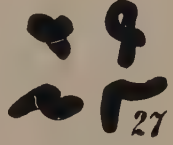
22



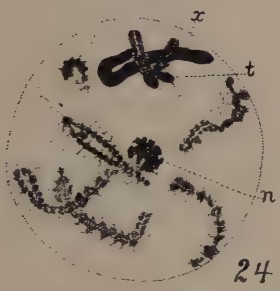
23



25

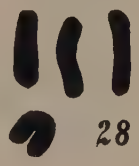


27

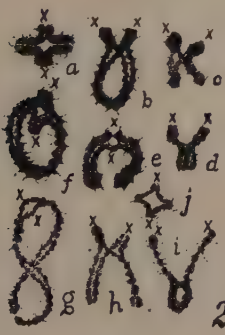


24

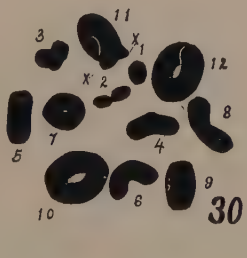
26



28



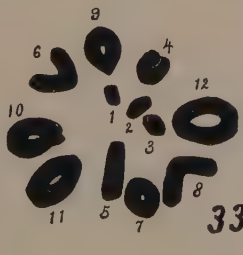
29



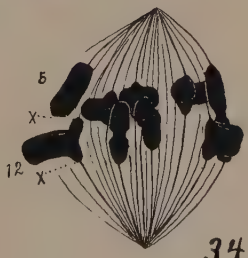
30

31

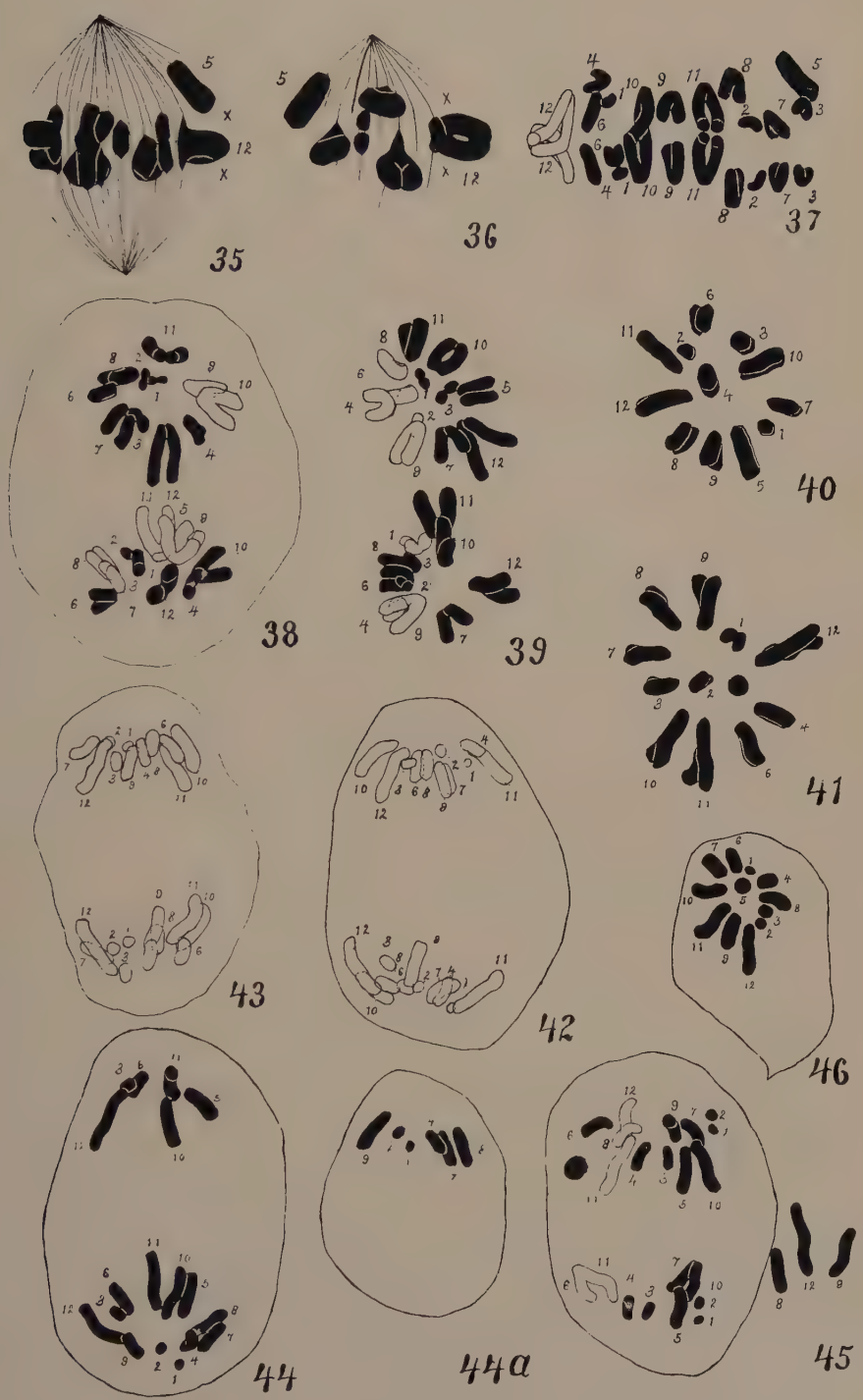
32



33



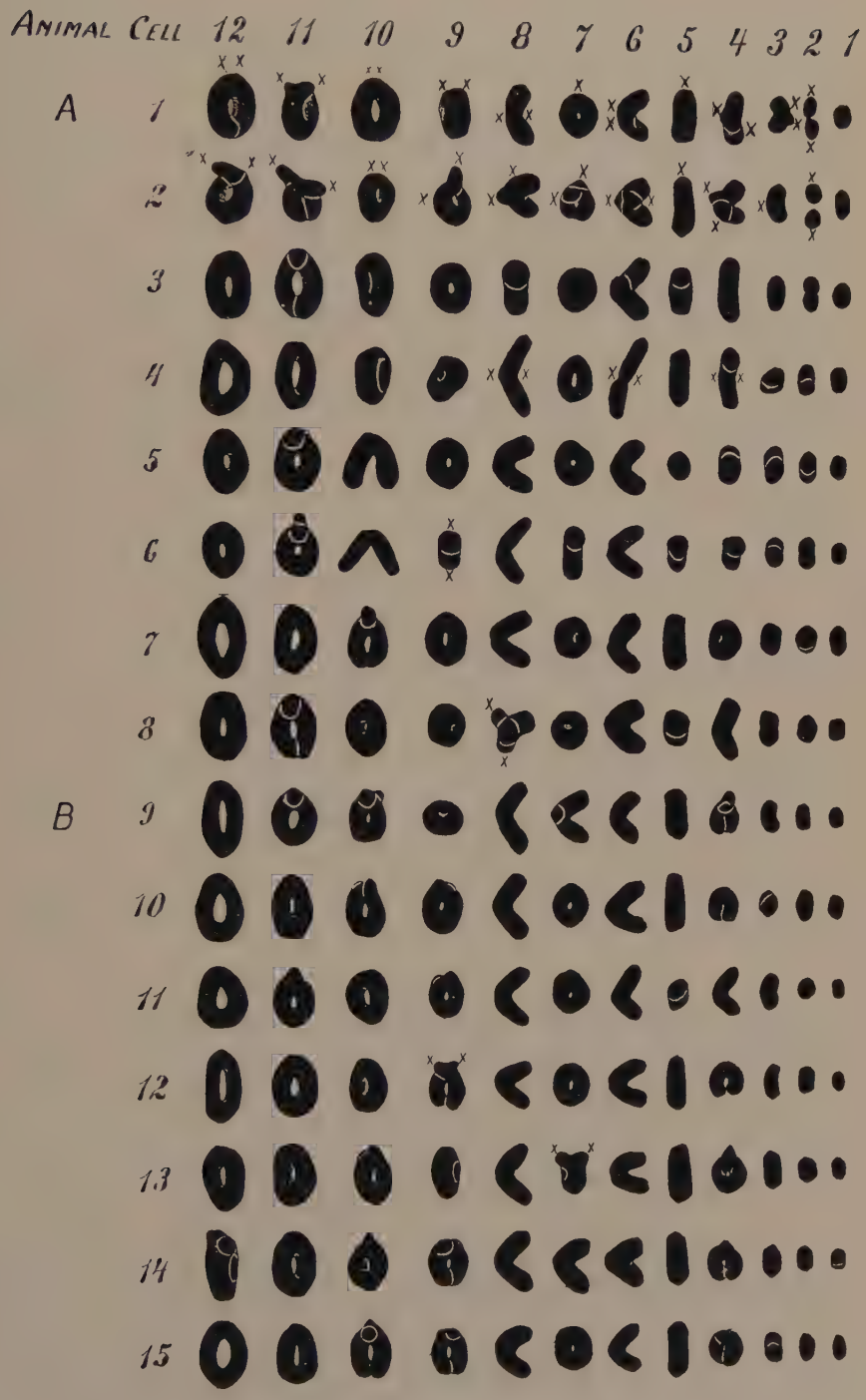
34

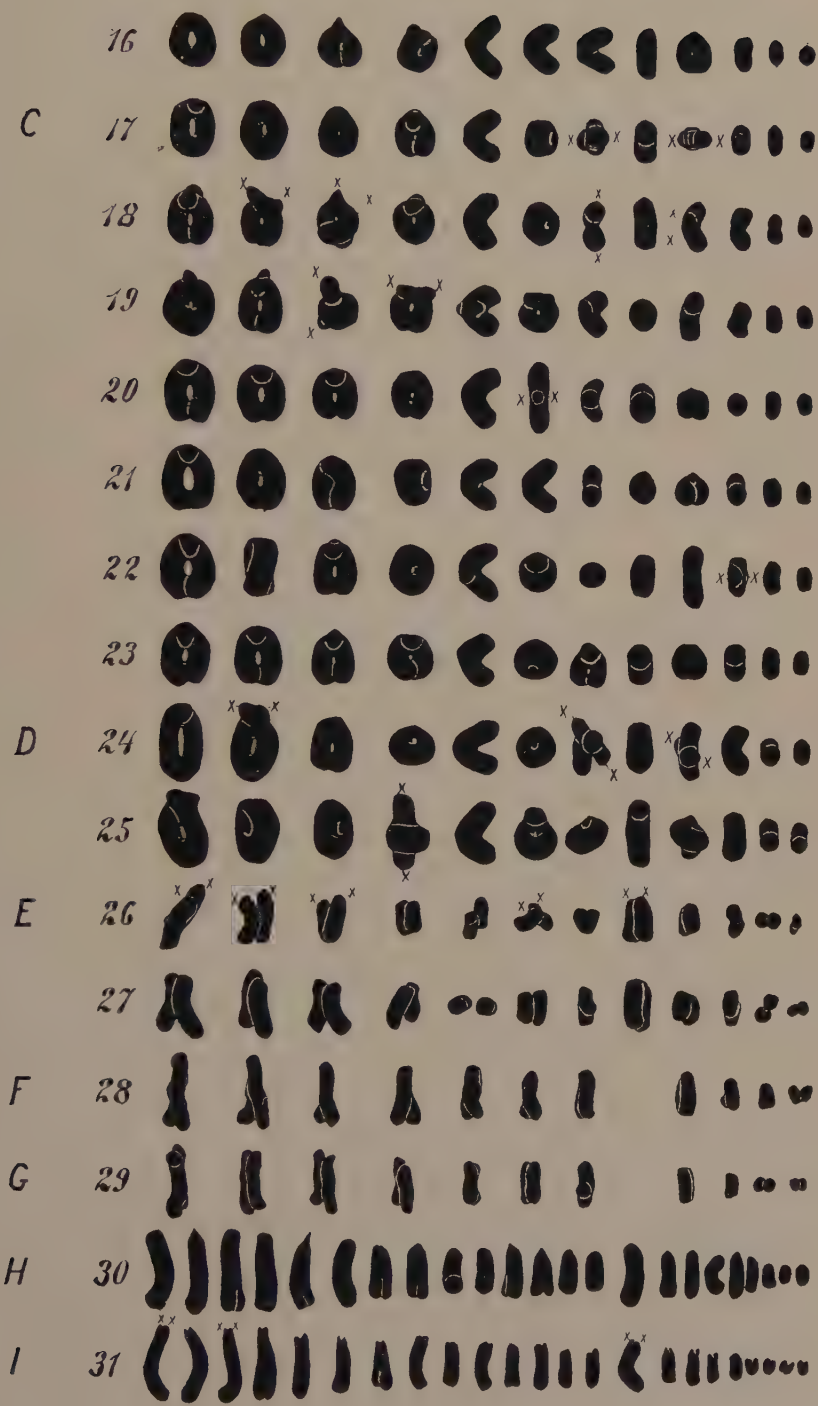

35
36
37
38
39
40
41
42
43
44
44a
45
46

EXPLANATION OF PLATES XXI, XXII.

The twelve chromosomes of each cell are arranged in a series or row horizontally. The series are placed one below the other, so that like chromosomes always appear in the same column. The number (at top of page) of the column in which a chromosome occurs is the number by which the particular individual chromosome which that column contains is known. The series or cell complex to which a chromosome may belong is indicated by the numbers at the left side of the plate. The capital letters at the left side of the plate designate the animal from which the series was taken. The characters *XX* indicate the proximal part of the chromosome, the point at which the spermatogonial pair conjugated. They also indicate the points of attachment of the spindle fibers, and in those chromosomes that are part way advanced into mitosis the ends of the transverse axis. In the second spermatocytes and the spermatogonia they indicate, as above, the attachment of the fibers and the proximal or polar end of the chromosome.

The first twenty-five series are taken from first spermatocyte metaphases, such as are seen in figures 30-33. Series 26-29 were taken from second spermatocyte metaphases, such as figures 40 and 41 (Series 28 is from fig. 41, plate XX); and series 30 and 31 were taken from the spermatogonial metaphases shown in figures 2 and 6 of plate XVIII. All of the series except 24 and 25 are from cells that were stained with iron-hæmatoxylin. Series 24 and 25 were stained with Flemming's tricolor, which has a tendency to swell the structures. The magnifications are the same as in the preceding plates and the drawings were made in the same way.


Animal Cell 12 11 10 9 8 7 6 5 4 3 2 1
A
1
2
3
4
5
6
7
8
B
9
10
11
12
13
14
15


16
C 17
18
19
20
21
22
23
D 24
25
E 26
27
F 28
G 29
H 30
I 31

EXPLANATION OF PLATE XXIII.

Drawings made from sections of the testis of Phrynotettix magnus.

FIG. 1.—Metaphase of a spermatogonial cell showing all of the chromosomes. (x) Accessory chromosome.

FIG. 2.—Typical spermatogonial cell in anaphase. (x) Accessory chromosome.

FIG. 3.—Telophase of the same showing the persisting spindle fibers.

FIG. 4.—Later telophase. Note the encroaching division-wall contracting the spindle. The section is cut parallel with the long axis of the chromosomal vesicles. (x) Accessory chromosome in longitudinal section. (a) Polar granule.

FIG. 5.—Cross-section of the chromosome group of a cell in the same stage as those shown in figure 4. The polar granule of the accessory is shown.

FIG. 6.—A telophase slightly later than that shown in figures 4 and 5. Polar granules located at the proximal ends of the chromosomes.

FIG. 7.—Cross-section through the proximal end of a group of chromosomes showing a number of polar granules.

FIG. 8.—A cross-section through the distal portion of a similar group. No chromatin bodies of definite form appear in this plane.

FIG. 9.—A typical spermatogonial cell showing the diffusion of chromatin at its maximum within the vesicles. This stage marks the end of the telophase.

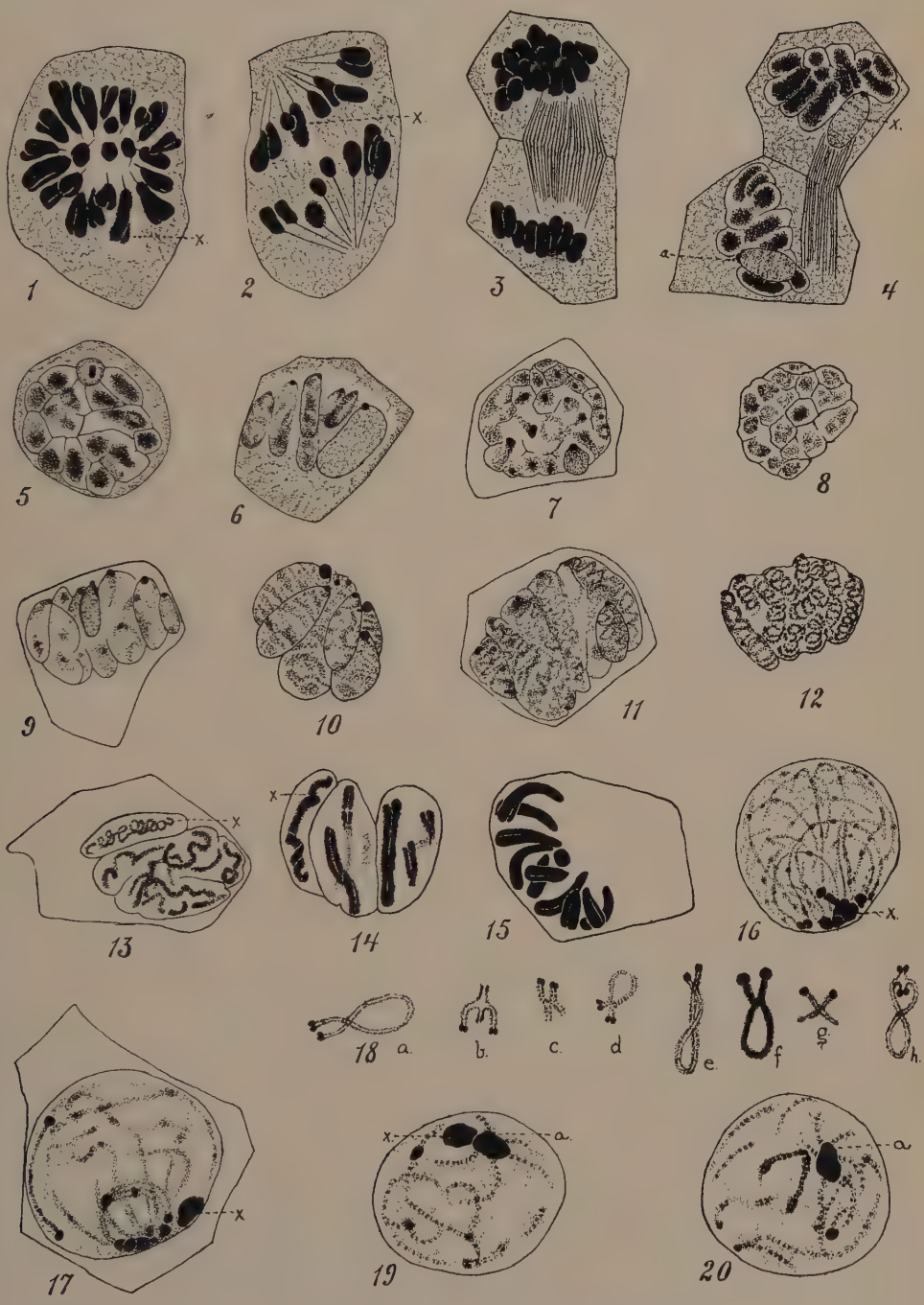
FIGS. 10, 11, 12, 13, 14, 15.—Cells showing the succession of typical changes occurring in the spermatogonial prophases. (x) Accessory chromosome.

FIG. 16.—Early spermatocyte prophase. (x) Accessory chromosome showing its characteristic position. The lesser bodies are the polar granules. Note the looped arrangement of the chromatin thread.

FIG. 17.—A slightly later spermatocyte prophase. The chromatin thread is contracting. (x) Accessory chromosome.

FIG. 18.—Spermatocyte tetrads. The bulbous thickening or polar granules mark the point of spindle fiber attachment. a, e, h, show the tetrads which later form the large rings shown in figures 22 and 23. (f) is a similar tetrad in a more condensed state. In (h) the separation resulting in bivalent chromosomes has begun. In (b) the separation has apparently progressed still further.

FIGS. 19, 20.—The same stage as shown in figure 17. (x) Accessory chromosome with no chromatin threads attached. (a) A deeply staining mass of homogeneous chromatin with radiating chromatin threads showing a longitudinal division. The chromomeres are in evidence.


1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
a.
b.
c.
d
e.
f
g
h.
x.

EXPLANATION OF PLATE XXIV.

FIG. 21.—Late prophase of first spermatocyte showing the quadrivalent character of the chromosomes.

FIGS. 22, 23.—First spermatocyte metaphases. Note the constancy in form and number of the chromosomes.

FIGS. 24, 25.—Succeeding metaphases following the stage shown in figure 23.

FIGS. 26, 27.—Anaphases of first spermatocyte.

FIG. 28.—Telophase of the first spermatocyte. The homogeneous condition of the accessory chromosome is characteristic. The bivalent character of the chromosomes is apparent.

FIG. 29.—Later telophase of the same. The polar granules are seen in the polar ends of the dyads.

FIG. 30.—Metaphase of the second spermatocyte showing twelve dyads.

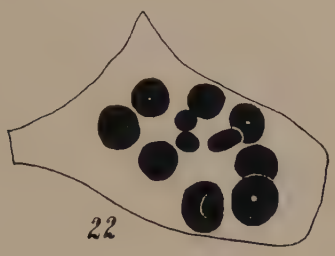
FIG. 31.—Same stage. A lateral view of the mitotic figure.

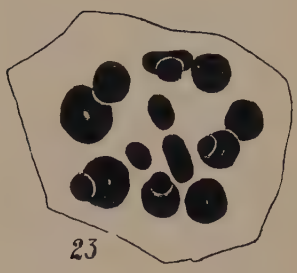
FIG. 32.—Anaphase of the second spermatocyte resulting in the separation of chromatids.

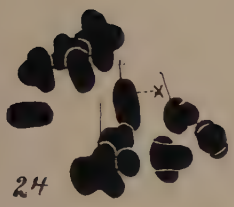
FIG. 33.—An early stage in the developing spermatid. (*a*) The spindle fiber remains. Note also the small round bodies staining like homogeneous chromatin within the nucleus.

FIG. 34.—A later stage in the developing spermatid. (*a*) Middle-piece staining like the chromatin bodies in the nucleus of figure 33.

21


22


23


24

25

26

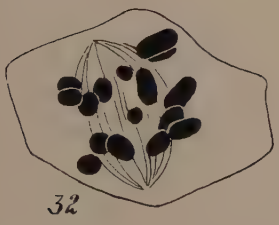
27

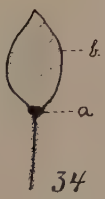
28

29

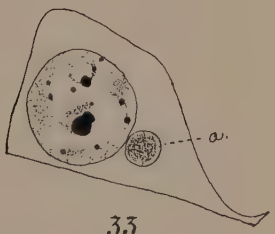
30

31


32



34



33

PLATE XXV.

Right lateral view of the skull of the wolf-eel, *Anarrhichthys ocellatus*, with suspensorium and mandible *in situ*. Natural size.

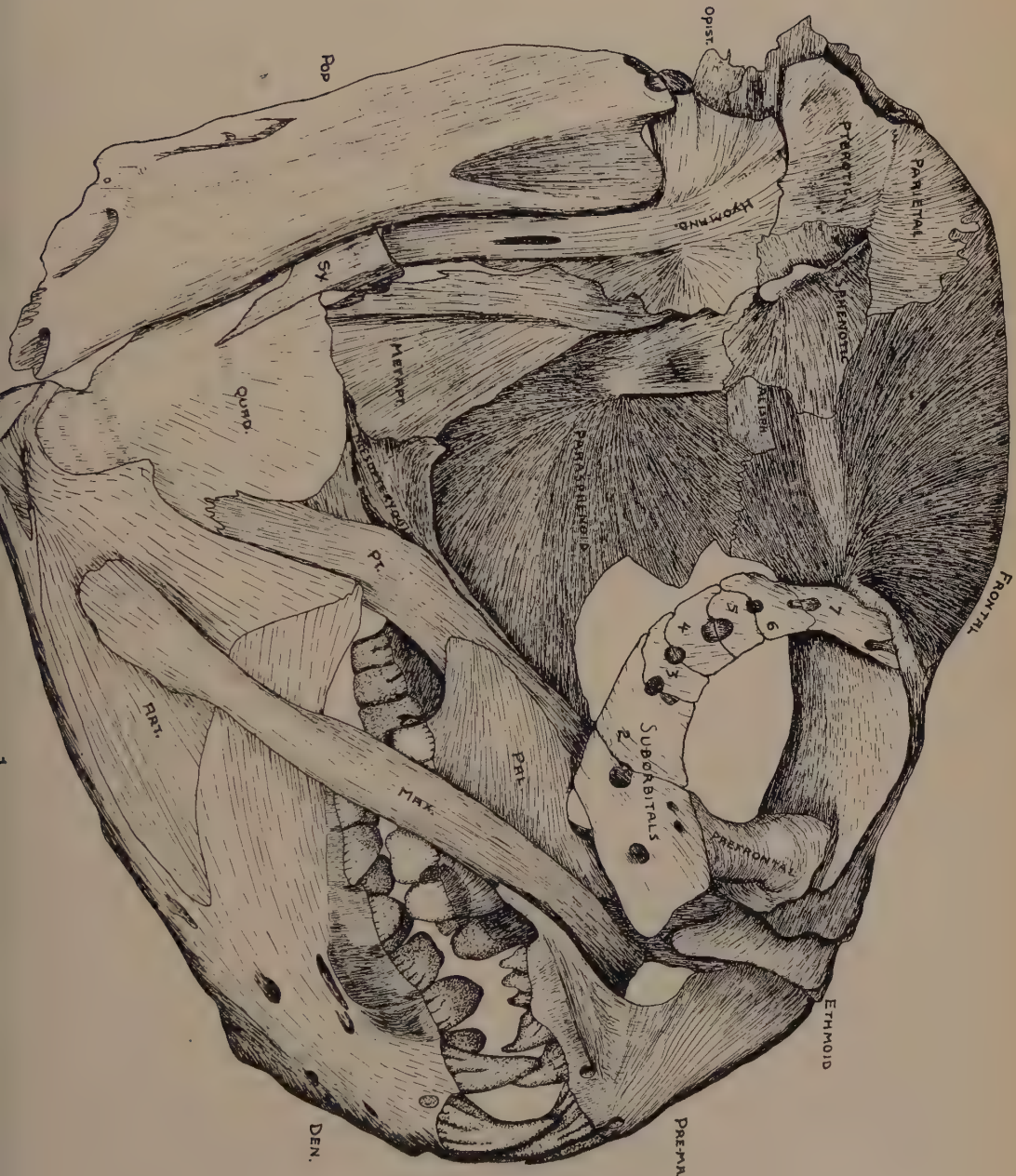
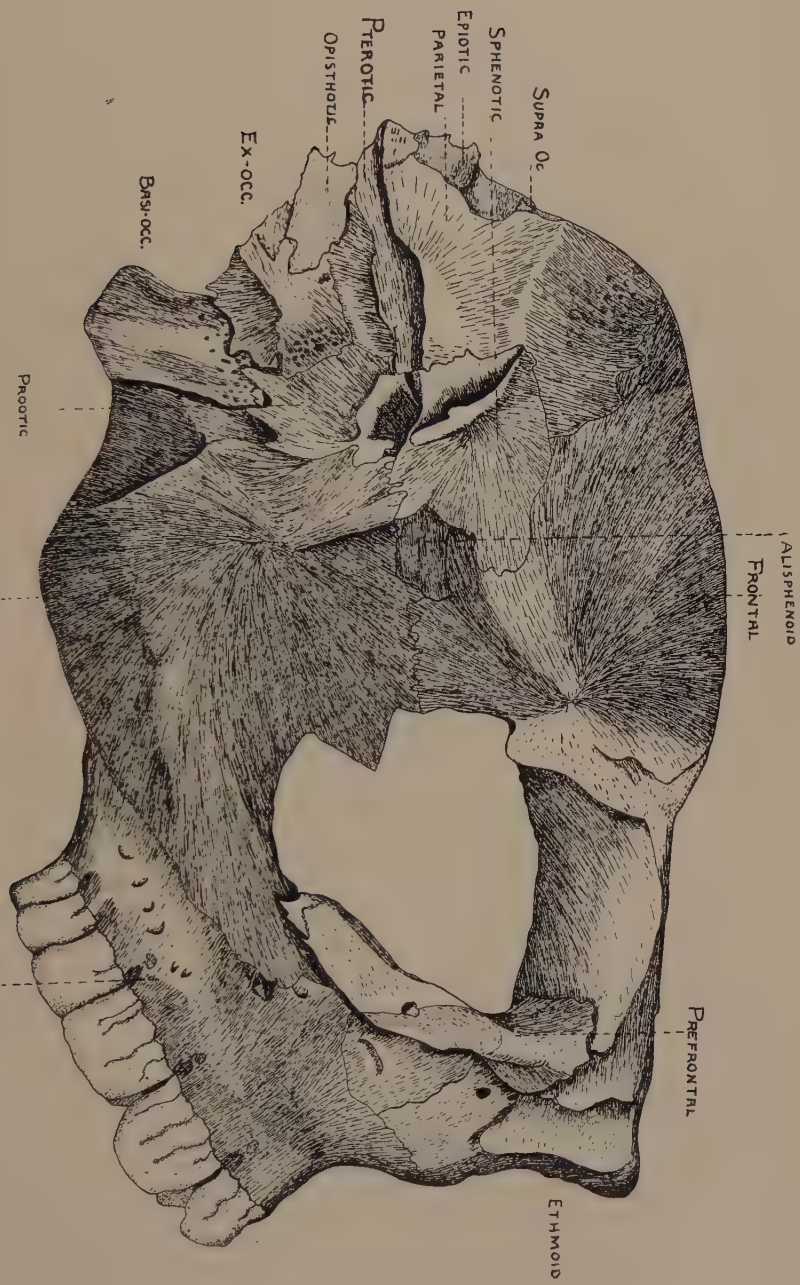

FRONTAL
PARIETAL
PTERYGOID
PREFROTIC
ALISPH.
HYOMAND.
OPIST.
POP
SQ.
METAPT.
QUAD.
PARASPHENOID
MESOPTERYGOID
PT.
ART.
PAL.
MAX.
SUBORBITALS
1
2
3
4
5
6
7
PREFRONTAL
ETHMOID
PRE-MAX.
DEN.

PLATE XXVI.

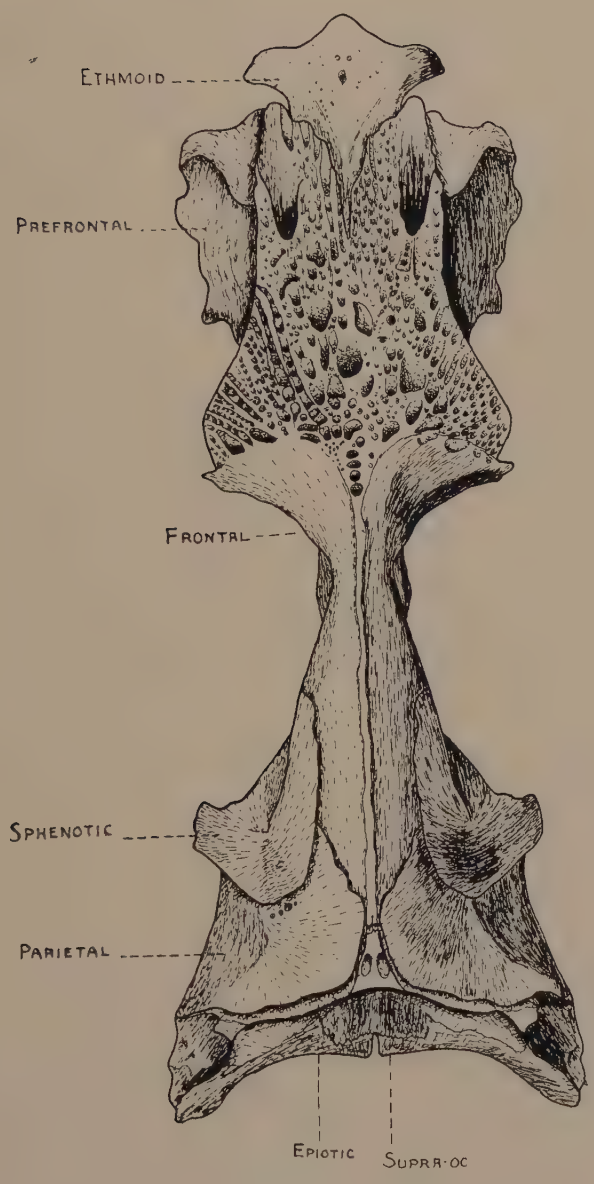
Right lateral view of the skull of *Anarrhichthys ocellatus*, stripped of the suspensorium and the mandible. Natural size.


Supra Oc.
Sphenotic
Epiotic
Parietal
Pterotic
Opisthotic
Ex-occ.
Basi-occ.
Prootic
Parasphenoid
Vomer
Alisphenoid
Frontal
Prefrontal
Ethmoid

2.

PLATE XXVII.

Dorsal view of the skull, stripped. Natural size.


ETHMOID
PREFRONTAL
FRONTAL
SPHENOTIC
PARIETAL
EPIOTIC
SUPRA-OC

3

PLATE XXVIII.

FIG. 4.—Posterior view of the stripped skull. Natural size.

FIG. 5.—Outer view of the premaxilla. Natural size.

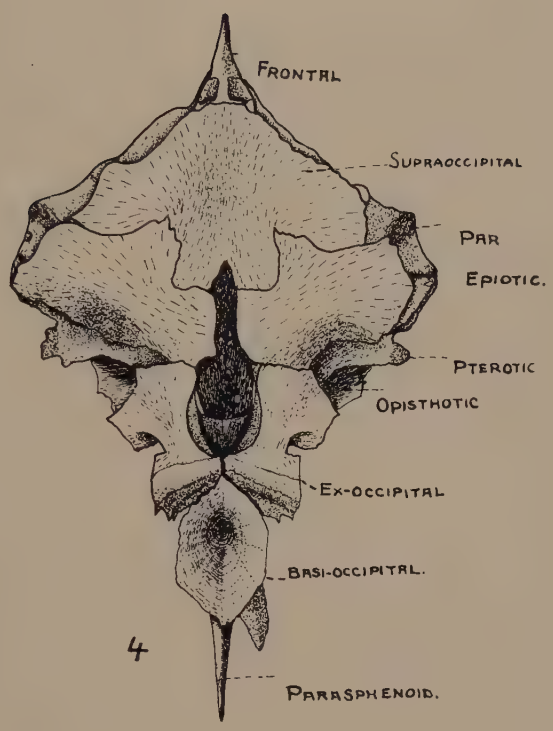
FIG. 6.—Premaxilla, inner view.

FIG. 7.—Longisection of tooth from premaxilla, X 2.

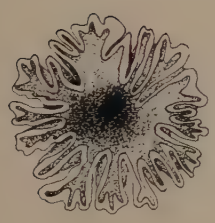
FIG. 8.—Basal view of canine, X 5.

7

×4


FRONTAL
SUPRAOCCIPITAL
PAR
EPIOTIC.
PTEROTIC
OPISTHOTIC
EX-OCCIPITAL
BASI-OCCIPITAL.
PARASPHENOID.

4



×10 8

5.

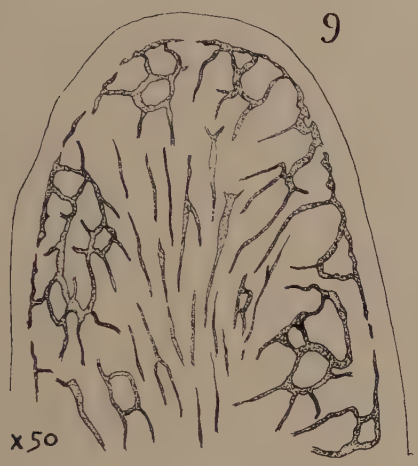
6.

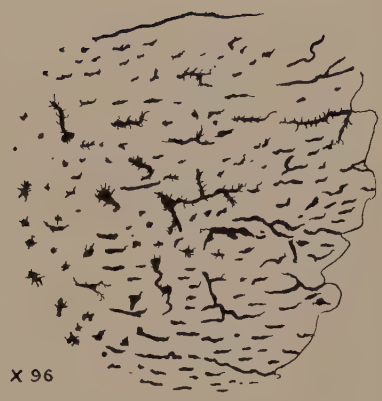
PLATE XXIX.

FIG. 9.—Longisection of a canine, X 25.

FIG. 10.—Transverse section of a canine, X 48.

FIG. 11.—Skull with the right half cut away.


9
x50


x 96
10

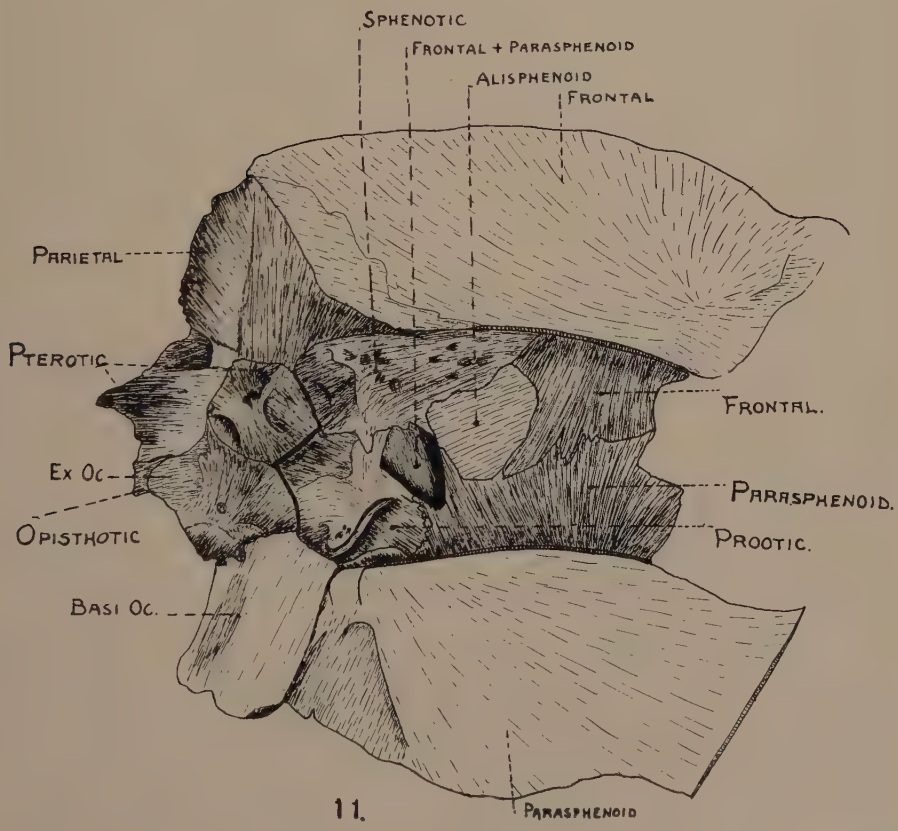

Sphenotic
Frontal + Parasphenoid
Alisphenoid
Frontal
Parietal
Pterotic
Ex Oc
Opisthotic
Basi Oc.
Frontal.
Parasphenoid.
Prootic.
Parasphenoid
11.

PLATE XXX.

FIGS. 12, 13, 14.—Right prootic, inner, anterior and exterior views.

FIG. 15.—Right opisthotic.

FIGS. 16, 17, 18, 19.—Right supraoccipital, posterior, lateral, dorsal and ventral views.

FIGS. 20, 21, 22, 23.—Basioccipital, posterior, anterior, lateral and ventral views.

FIG. 24.—Vomer, ventral view. Natural size.

INTERIOR

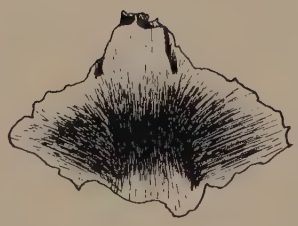
12

ANTERIOR.

13

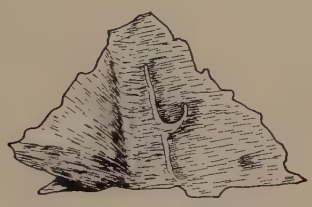
EXTERIOR

14

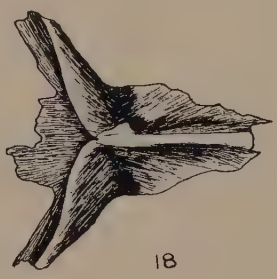


16

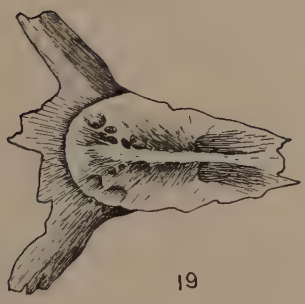
15.



17



18

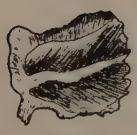


19

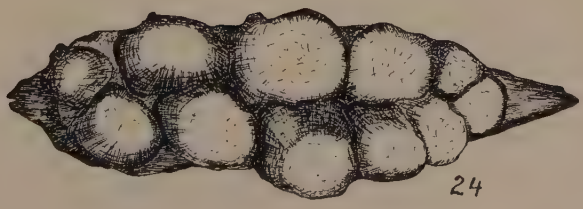
20

21

22



23



24

PLATE XXXI.

FIGS. 25, 26.—Mesopterygoid, outer and inner views.
FIGS. 27, 28.—Metapterygoid, outer and inner views.
FIGS. 29, 30, 31.—Epiotic—inner, dorsal and posterior views.
FIGS. 32, 33, 34.—Exoccipital—outer, posterior and inner views.
FIG. 35.—Frontal, lateral view. Natural size.

25

26

27

28

29

30

31

32.

33.

34.

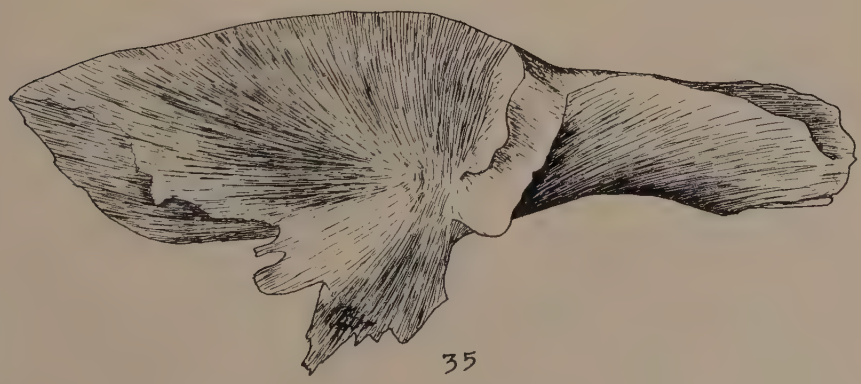

35

PLATE XXXII.

FIG. 36.—Frontal, ventral view.

FIGS. 37, 38, 39.—Prefrontal—lateral, dorsal and inner views.

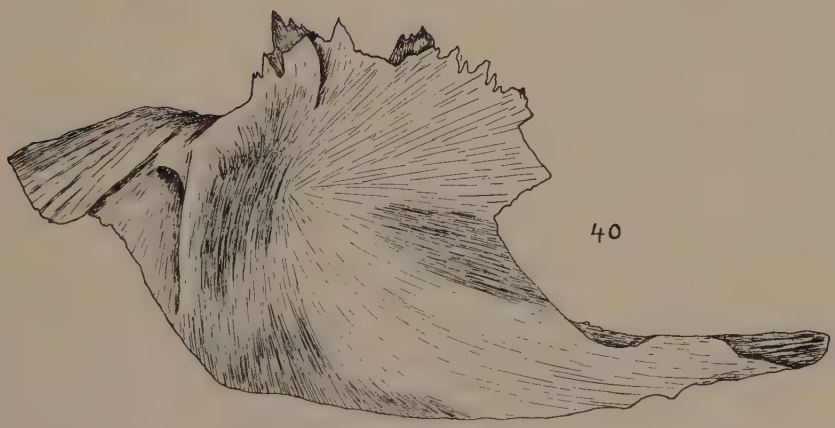
FIGS. 40, 41.—Parasphenoid—lateral and dorsal views. Natural size.

36

39.

38.

37.



40

41.

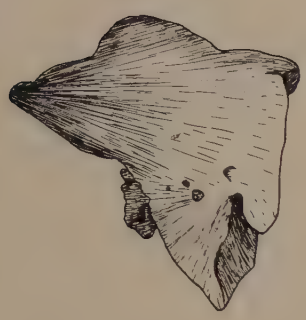
PLATE XXXIII.

FIGS. 42, 43, 44.—Ethmoid—lateral, dorsal and anterior views.

FIG. 45.—Alisphenoid, outer face.

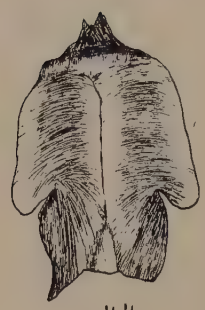
FIGS. 46, 47, 48.—Sphenotic—outer, posterior and inner views.

FIGS. 49, 50, 51, 52.—Parietal and pterotic—lateral, inner, anterior and posterior views.

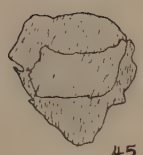


42

43



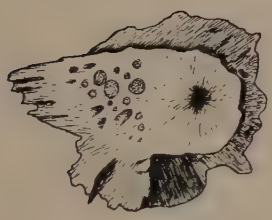
44



45

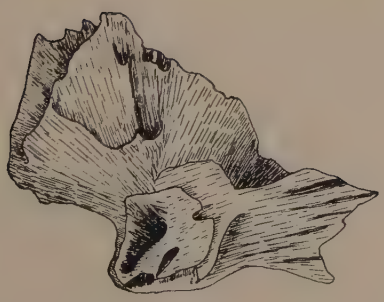
46

47



48

49



50

51

52

PLATE XXXIV.

FIGS. 53, 54.—Preopercular, outer and inner views.

FIGS. 55, 56.—Hyomandibular, inner and outer faces.

53

54

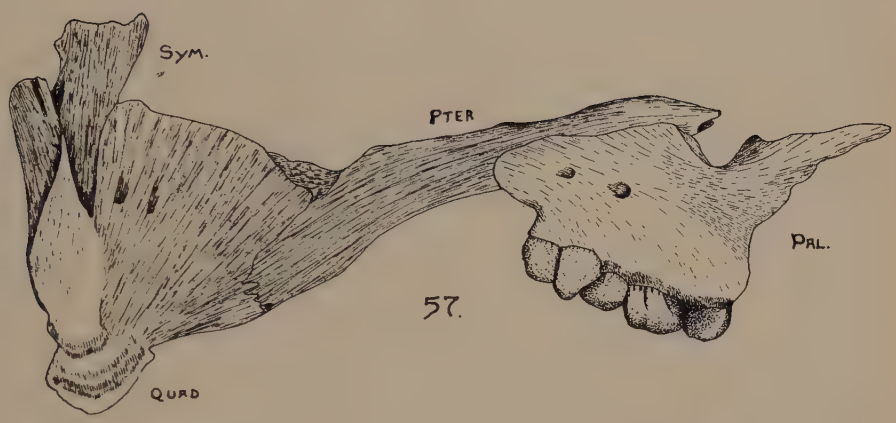
55

56.

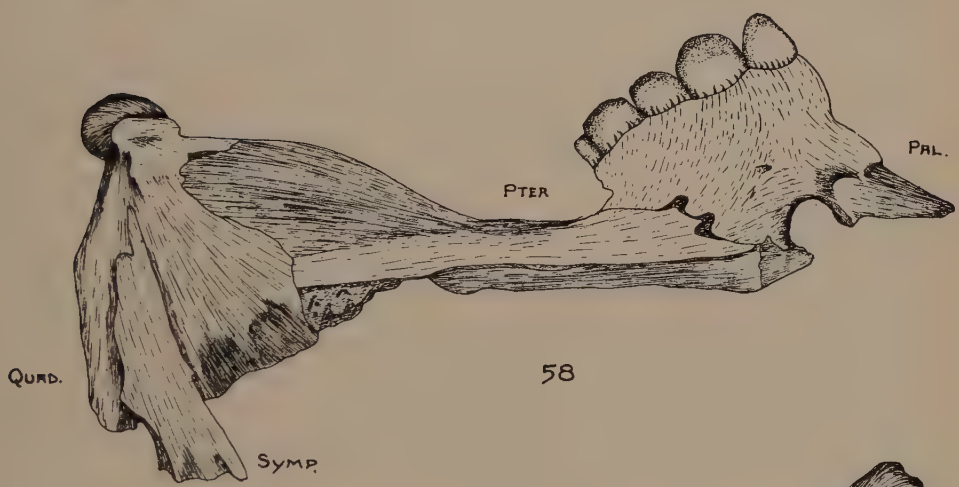
PLATE XXXV.

FIGS. 57, 58.—Quadrate, symplectic, pterygoid, palatine, outer and inner views.

FIGS. 59 (marked 58 on plate), 60.—Maxilla, inner and outer views.

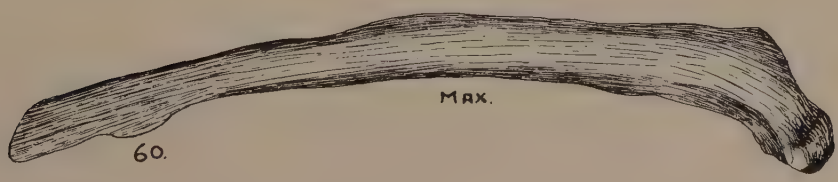


57.



58

58.



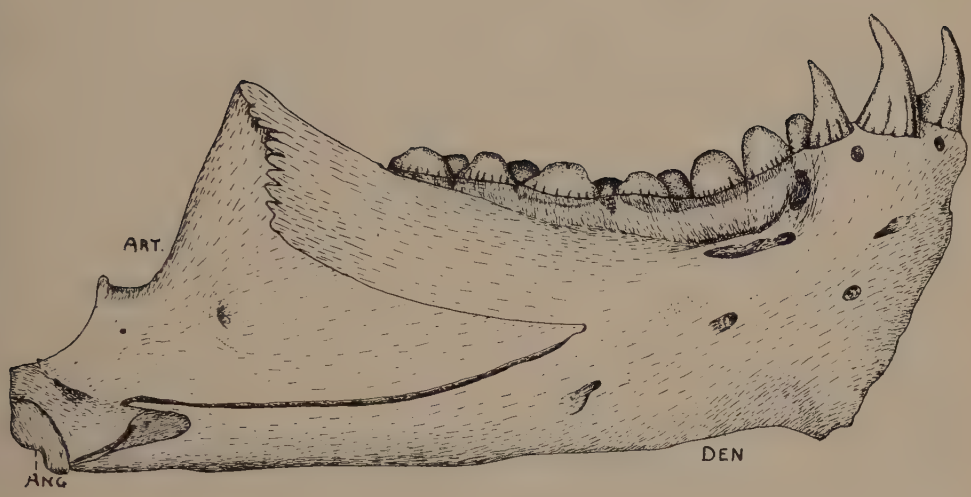
60.

PLATE XXXVI.

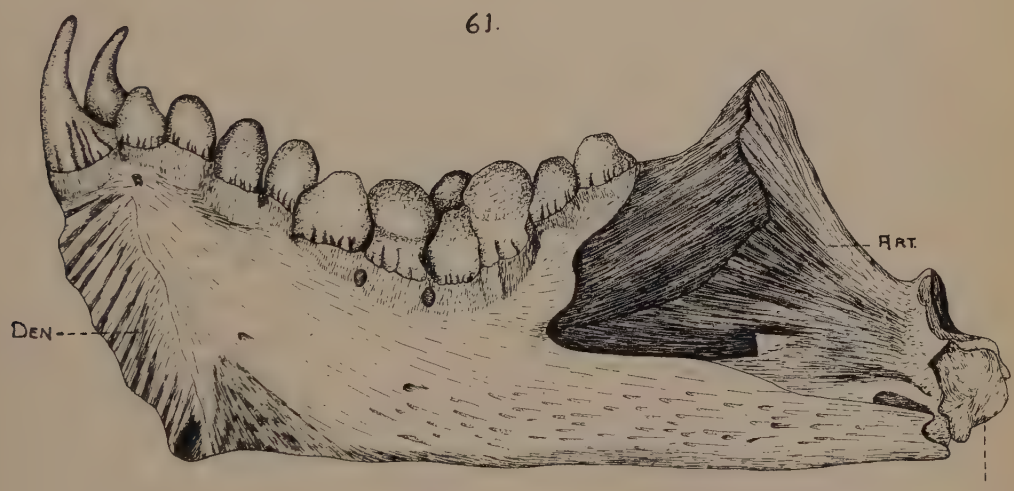
FIG. 61.—Mandible, outer view, showing dentary, angulare and articulare.

FIG. 62.—Inner view of the mandible.

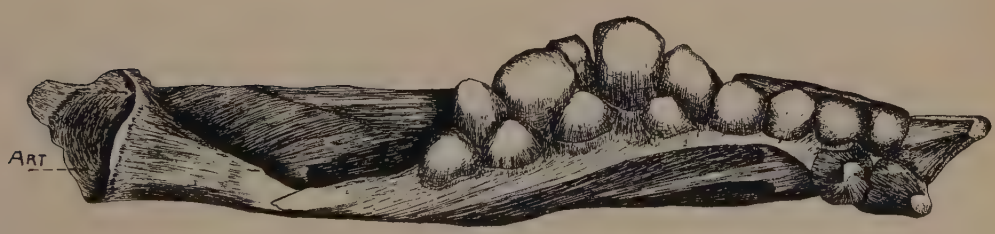
FIG. 63.—Mandible, dorsal view.



61.



62.



63.

EXPLANATION OF PLATE XXXVII.

FIG. 1.—Ventral view of grasshopper, showing heart-tube and some of the tracheal tubes in place in the chitin, but all other systems are removed. *a*, Air-sacs; *h*, heart-tube; *t*, tracheal tube; *m*, alary muscles, showing attachment; *s*, muscles connecting segments of abdomen.

FIG. 2.—Histological cross-section through heart. *a*, Alary muscles; *b*, fibrous layer; *c*, connective-tissue or pericardial cells; *d*, connective-tissue cells; *e*, ganglion-cells (?); *f*, muscle of heart; *h*, heart cavity; *t*, tracheal tubes; *i*, nerve-like cells. (Chrome-oxalic fixative, Nissl stain).

FIG. 3.—Longitudinal section of heart with corresponding structures labeled same as for figure 2. (Formalin fixative, iron-hæmatoxylin stain.)

FIG. 4.—So-called ganglion-cells. Same as *e*, figures 2 and 3. (Formalin fixative, iron-hæmatoxylin stain.)

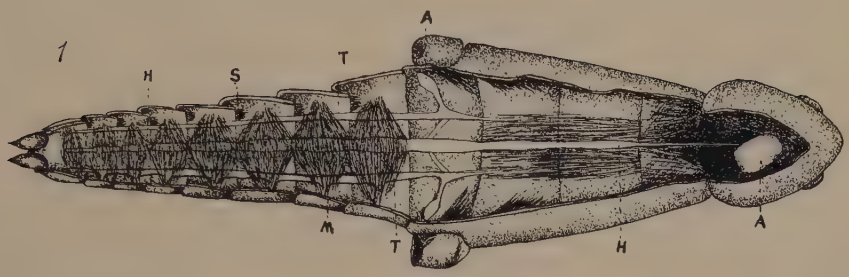
FIG. 5.—Pericardial cells, enlarged. Same as *c*, figures 2 and 3.

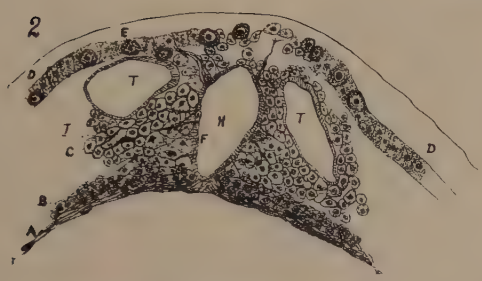
FIG. 6.—Connective-tissue cells enlarged. Same as *d*, figures 2 and 3. (Figures 5 and 6, chrome-oxalic fixative, Nissl stain.)

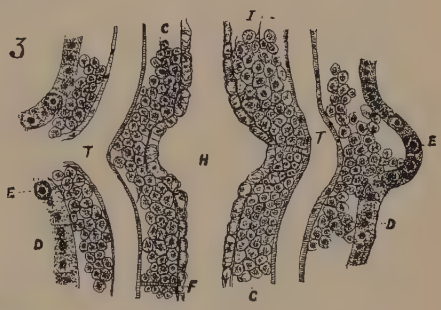
FIG. 7.—*a*, Cross-section of heart-muscle (*f*, of figure 2); *b*, single fiber from cross-section of heart. (Figure 7, *a* and *b*, formalin fixative, iron-hæmatoxylin stain.)

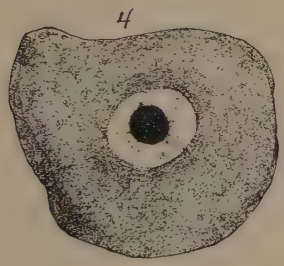
FIG. 8.—Longitudinal section through heart-muscle (*f*, figure 3), showing fibers and nerve-like cells (*n*). (Stain and fixative same as for figure 7.)

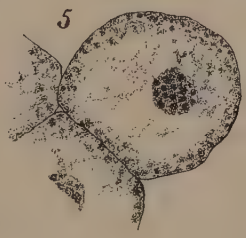
FIG. 9.—Section through a thoracic ganglion. (Van Gehuchten's fixative, Nissl stain, with erythrosin for a counter-stain.)

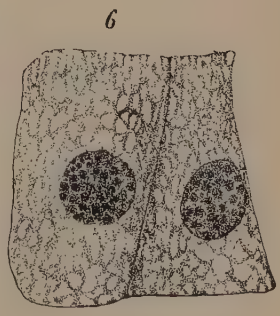

1
A
T
H
S
M
T
H
A


2
E
D
T
I
C
H
F
T
D
B
A


3
C
I
T
H
T
E
E
D
D
F
C


4

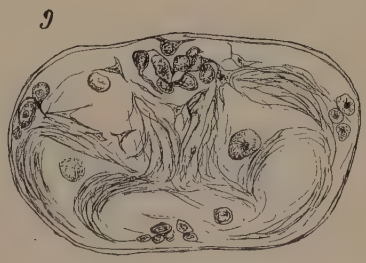

5


6

7a

7b

8
N


9

EXPLANATION OF PLATE XXXVIII.

FIG. 1. Skull found at San Blas. Lateral view. × ½.

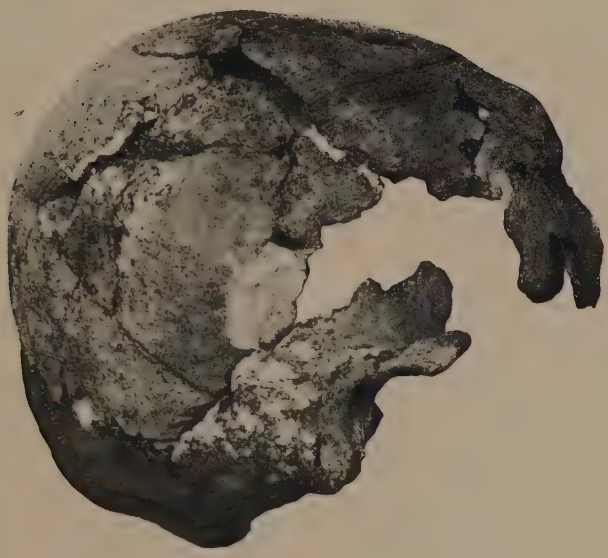
FIG. 2. Camp of the University of Kansas expedition to Patagonia on Señor H. S. Felton's estancia, showing location where the Killik Aike skull, shown on plate 39, was found. Exact spot indicated by the small x.

ROCK
JAY
KU

EXPLANATION OF PLATE XXXIX.

FIG. 1. Lateral view of Killik Aike skull found on Señor H. S. Felton's estancia, Rio Gallegos, Patagonia, locality shown in text figure 1.

FIG. 2. Superior view of Killik Aike skull.



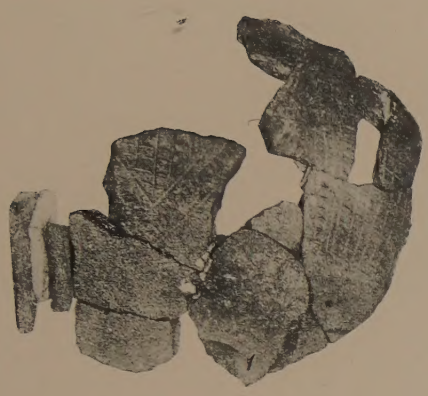
2

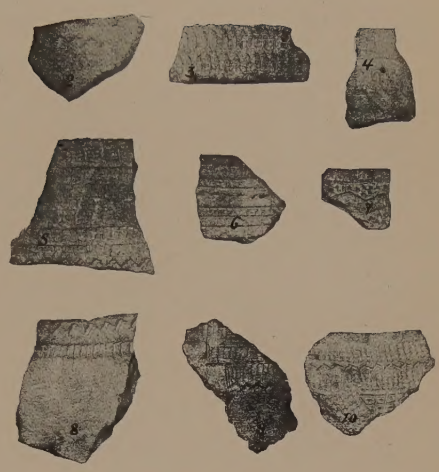
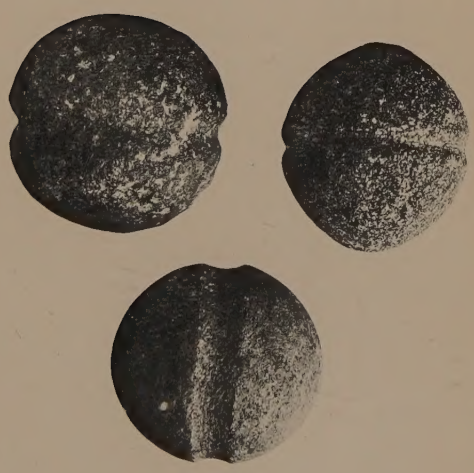
EXPLANATION OF PLATE XL.

FIGS. 1-10, inclusive, represent pottery found associated with skull shown on plate 38, fig. 1, from San Blas, Rio Negro Territory, Argentine Republic.

Lower left-hand figures show arrow points found with above skull.

Lower right-hand figures show boleadores found on the estancia of Señor H. S. Felton, Rio Gallegos, Patagonia.


1


2
3
4
5
6
7
8
10